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SUBSTITUTE SPECIFICATION

DISPOSABLE DIAPER

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BACKGROUND OF THE INVENTION

This invention relates to a disposable diaper for absorption and containment of excrement.

Japanese Utility Model Application Publication No. 1989-141707A describes a disposable diaper having an absorbent pad that is divided into a plurality of pad sections. Each of the pad sections comprises a mixture of fluff pulp fibers/superabsorbent polymer particles and a topsheet joined to a backsheet around the pad section so that a groove depressed from the side of the topsheet toward the side of the backsheet may be defined between each pair of the adjacent pad sections.

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Japanese Patent Application Publication No. 1997-51913A describes a disposable absorbent undergarment that includes a liquid-absorbent core formed with a plurality of slits extending through a thickness direction of the core and arranged intermittently in a longitudinal direction of the undergarment as well as in a transverse direction

orthogonal to the longitudinal direction so that topsheet and backsheet may be bonded together along the slits.

With conventional disposable undergarments, the topsheets and backsheets are joined together at bottoms of grooves or slits. As a result, the amount of urine flowing into the grooves or slits can only be absorbed by the core through side walls of the grooves or slits. With such an

*pm 3-31-07* undergarment, the surface area of the core that is available to absorb body fluids is reduced as the width of the groove or slit is enlarged. Consequently, the absorption rate and capacity for body fluids is correspondingly reduced.

#### SUMMARY OF THE INVENTION

It is an object of this invention to provide a disposable diaper designed so that a width of each groove formed on the side of the diaper's topsheet can be enlarged without reduction in the surface area of the core available to absorb body fluids.

This invention provides a disposable diaper comprising a liquid-pervious topsheet, a liquid-impervious backsheet and a liquid-absorbent core covered with an absorbent and diffusive sheet and disposed between the topsheet and the backsheet. The core is formed on a side of the topsheet

with at least one groove depressed in a direction from a side of the topsheet toward a side of the backsheet. The groove has a bottom and side walls <sup>which</sup> are both covered with the topsheet. <sub>A</sub>

The core contains water-absorbent fibers and superabsorbent polymer particles. The water-absorbent fibers and superabsorbent polymer particles are partially disposed between the topsheet and backsheet along the bottom of the groove.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partly cut away plan view showing a diaper according to a typical embodiment of the invention;

Fig. 2 is a sectional view taken along section line II - II in Fig. 1;

Fig. 3 is a view similar to that in Fig. 1, showing another embodiment of the invention;

Fig. 4 is a view similar to that in Fig. 2, showing still another embodiment of the invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Details of a disposable diaper according to this invention will be more fully understood from the

description of its embodiments given hereunder with reference to the accompanying drawings.

Diaper 1 shown in Fig. 1 in a partially cutaway plan view comprises a liquid-pervious topsheet 2, a liquid-impervious backsheet 3 and a liquid-absorbent core 4 disposed between topsheet 2 and backsheet 3. The diaper 1 has a front waist region 6, a rear waist region 7 and a crotch region 8 that extends between front waist region 6 and rear waist region 7. The topsheet 2 and backsheet 3 extend outward beyond a peripheral edge of the core 4 so as to overlap one another. The overlapped portions of the topsheet 2 and backsheet 3 are water-tightly joined together. Elastic members 16 and 17 are secured under tension to the inner surface of the topsheet 2 and/or backsheet 3 along respective longitudinally outer end portions 11, 12 of the front and waist regions 6, 7 so as to be associated with a waist-opening. Likewise, elastic members 18 are secured under tension to the inner surface of the topsheet 2 and/or backsheet along transversely opposite side edge portions 13 of the crotch region so as to be associated with leg-openings. The rear waist region 7 is provided on transversely opposite side edge portions 19 with tape fasteners 21. Grooves 15 are formed in the inner surface of the diaper 1 along transversely opposite side

edge portions 22 of the core 4. The grooves 15 extend in parallel to each other in the longitudinal direction of the diaper 1.

Fig. 2 is a sectional view taken along section line II - II in Fig. 1. The core 4 comprises a mixture of fluff pulp fibers 31 and superabsorbent polymer particles 32 and is entirely wrapped in an absorbent and diffusive sheet 33 such as tissue paper. The core 4 has a thickness  $\underline{t}$  in a transversely middle zone of the crotch region 8. Along each of the grooves 15, the core 4 is depressed in a direction from the topsheet 2 toward the backsheet 3. The inner surface of groove 15 is covered with the topsheet 2 and the absorbent and diffusive sheet 33 lies directly beneath the topsheet 2. The groove 15 has a bottom 34 and side walls 36. Referring to Fig. 2,  $\underline{d}$  designates a depth of the groove 15 as measured from a body-side surface 37 of the diaper 1 in the vicinity of the groove 15 to the bottom 34,  $\underline{p}$  designates a thickness of the core 4 as measured from the bottom 34 to the backsheet 3 and  $\underline{w}$  designates a width of the groove 15 as measured at the level of the body-side surface 37.

In diaper 1, the core 4 preferably has a basis weight of about 200 - 700 g/m<sup>2</sup>, a thickness  $\underline{t}$  of about 2 - 20 mm and contains about 98 - 5 % by weight of comminuted pulp

and about 2 - 95 % by weight of superabsorbent polymer particles. The density at which the polymer particles 32 are distributed within the core 4 gradually increases in the thickness direction of the core 4 from the topsheet 2 toward the backsheet 3. The polymer particles 32 are present in the vicinity of the bottom 34 as well as in the vicinity of the side walls 36 of the grooves 15 and are partially joined together with the absorbent and diffusive sheet 33 by means of an appropriate adhesive such as a hot melt adhesive (not shown). Joining of the polymer particles 32 and the absorbent and diffusive sheet 33 may also be achieved by compressing at least one of the core 4 and the absorbent and diffusive sheet 33 in desired regions under wet conditions, The absorbent and diffusive sheet 33 is joined to the topsheet 2 over the bottoms 34 and the side walls 36 of groove 15 by means of an adhesive (not shown). The groove 15 preferably has a width w of about 2 - 20 mm, a length L (See Fig. 1) of at least 20mm and the depth d corresponding to about 10 - 90 % of the thickness t of the core 4. The thickness p of the core 4 as measured from the bottom 34 of the groove 15 to the backsheet 3 corresponds to about 10 - 90 % of the thickness t of the core 4.

Such a unique arrangement of the diaper 1 allows an amount of body fluids, for example, urine flowing on the topsheet 2 transversely of the diaper 1 to be collected in the grooves 15 and thereby the amount of body fluids is prevented from leaking sideways. The amount of body fluids collected in the grooves 15 spreads in the longitudinal direction of the diaper 1 along the respective grooves 15, and is thereupon absorbed by the core 4 through the bottoms 34 and the side walls 36. A plurality of superabsorbent polymer particles 32 joined to the absorbent and diffusive sheet 33 defining the bottoms 34 as well as the side walls 36 swell as soon as they absorb the body fluids and cohere together so as to form gel block extending along the surface of the respective grooves 15. The presence of such gel block serves to protect the grooves 15 from completely collapsing under a wearer's body weight and, in consequence, having their function impaired. It should be understood here that the gel block also functions to obstruct further permeation of the body fluids into a depth of the core 4. To overcome this problem, it is preferred to distribute the fluff pulp fibers 31 at a density higher than that of the superabsorbent polymer particle 32 in the vicinity of tops of the respective side walls 36 as will be best seen in Fig. 2. In the vicinity of the entire side

walls 36, the superabsorbent polymer particles 32 may be mixed with sufficient amount of the fluff pulp fibers 31 so that the fluff pulp fibers 31 may partially extend through the gel block and thereby assist the body fluids in permeating from the grooves 15 further into the depth of the core 4.

As will be apparent from the foregoing description, the core 4 is adapted to not only absorb the body fluids through its flat body-side surface but also through the bottoms 34 and the side walls 36 of the respective grooves 15. This feature reliably overcomes the disadvantage associated with the diaper of prior art, i.e. when the grooves formed by joining the topsheet and backsheet together necessarily reduces the surface area of the core that is available to absorb the body fluids. Along the bottoms 34 and the side walls 36 of the core 4, the superabsorbent polymer particles 32 are joined to the absorbent and diffusive sheet 33 so that the polymer particles 32 are not scattered far away from the vicinity of the grooves 15 even when the grooves 15 are more or less deformed as a wearer's body weight is exerted on the core 4. The core 4 may contain 20 % by weight or less of thermoplastic synthetic fibers and preferably thermoplastic synthetic fibers that have a melting point of  $100^{\circ}\text{C} \pm 20^{\circ}\text{C}$ .



When the core 4 is partially heated under pressure to form the grooves 15, the thermoplastic synthetic resin melts and deforms to facilitate the formation of the grooves 15. The distribution of the polymer particles 32 in the core 4 may be varied in different regions of the core 4. For example, the density at which the polymer particles 32 are distributed in the region defined between the transversely adjacent grooves 15, 15 may be adjusted to be higher than the density at which the polymer particles 32 are distributed outside the respective grooves 15 in order to ensure that most of the body fluids is absorbed by the core 4 in the region defined between the grooves 15, 15 and thereby prevent the body fluids from leaking sideways.

Fig. 3 is a view similar to that in Fig. 1, showing another embodiment of the invention. The diaper 1 shown in Fig. 3 has two grooves 15 formed in the diaper's transversely middle zone which grooves 15 extend in the longitudinal direction of the diaper 1. These two grooves 15 can be spaced apart from each other in the longitudinal direction, if desired. The groove 15 in Fig. 3 has the same cross-sectional shape as that of the groove 15 illustrated in Fig. 2. Most of the body fluids discharged on the diaper 1 flow in the groove(s) 15 longitudinally in the middle zone and then are rapidly absorbed by the core 4

through the bottoms 34 and the side walls 36. In this way, the amount of the body fluids capable of flowing in the transverse direction of the diaper 1 is limited.

Therefore, according to this embodiment the groove(s) can prevent the body fluids from leaking sideways with respect to the diaper 1 without reducing the surface area of the core 4 that is available to absorb the body fluids.

Fig. 4 is a view similar to that in Fig. 2, still another embodiment of the invention. In the case of this diaper 1, a thin layer 41 of the fluff pulp fibers 31 is closely joined to the inner surface of the absorbent and diffusive sheet 33 along the bottoms 34 and the side walls 36 of the grooves 15. The density of the fluff pulp fibers 31 is higher in a thin layer 41 around grooves 15 as shown in Fig. 4. The superabsorbent polymer particles 32 are present inside this thin layer 41. In this diaper 1, the surface area of the core 4 that is available to absorb the body fluids is not reduced by the presence of the grooves 15, because the thin layer 41 containing the higher density of fluff pulp fibers accelerates the flow of body into the grooves 15 for subsequent absorption by the core 4.

The present invention is applicable to baby diapers and adult diapers. Furthermore, the invention can be in the form of an open-type diaper as illustrated in the

figures and also in the form of pants-type diapers in which the front waist region 6 and the rear waist region 7 have been connected to each other along transversely opposite side edge portions thereof by means of welding or the other appropriate techniques.

In the disposable diaper according to this invention, the superabsorbent polymer particles and the fluff pulp fibers are disposed between the topsheet and backsheet in the vicinity of the bottoms of the grooves formed in the core and consequently the surface area of the core that is available to absorb the body fluids is not reduced by the presence of the grooves.

The superabsorbent polymer particles are joined integrally with the absorbent and diffusive sheet along the respective grooves. The absorbent and diffusive sheet is in close contact with the inner surface of the topsheet. This arrangement prevents the superabsorbent polymer particles from being scattered far away from the vicinity of the grooves even when the grooves are deformed under exertion of a wearer's body weight thereon.